uppermost surface of the III-N materials, and prior to deposition of electrode **39**, the structure can be etched using an etch chemistry that etches III-N materials at a higher etch rate than that of the materials used for electrode-defining layer **33** and passivation layer **22**. For example, when electrode-defining layer **33** and passivation layer **22** are both SiN_x, a Cl_2 RIE or ICP etch can be performed, resulting in the recess extending into the III-N material structure. The device of FIG. **8** can be formed using the procedures described above, with the exceptions that source and drain ohmic contacts **14** and **15**, respectively, are formed in place of the cathode contact **18**, and the step of etching the passivation layer **22** is omitted. The procedures for forming the devices of FIGS. **9** and **10** are the same as the procedures for forming those of FIGS. **5** and **8**, respectively, with the exception that the III-N layers formed on the substrate in FIGS. **9** and **10** have a different crystallographic orientation as compared to the III-N layers formed on the substrate in FIGS. **5** and **8**.

[0066] A number of implementations have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the techniques and devices described herein. Features shown in each of the implementations may be used independently or in combination with one another. Accordingly, other implementations are within the scope of the following claims.

What is claimed is:

1. A III-N semiconductor device, comprising:

an electrode-defining layer having a thickness on a surface of a III-N material structure, the electrode-defining layer having a recess with a sidewall, the sidewall comprising a plurality of steps, wherein a portion of the recess distal from the III-N material structure has a first width, and a portion of the recess proximal to the III-N material structure has a second width, the first width being larger than the second width; and

an electrode in the recess, the electrode including an extending portion over the sidewall, a portion of the electrode-defining layer being between the extending portion and the III-N material structure; wherein

the sidewall forms an effective angle of about 40 degrees or less relative to the surface of the III-N material structure.

2. The device of claim **1**, wherein the III-N material structure comprises a first III-N material layer, a second III-N material layer, and a 2DEG channel induced in the first III-N material layer adjacent to the second III-N material layer as a result of a compositional difference between the first III-N material layer and the second III-N material layer.

3. The device of claim **2**, wherein the first III-N material layer includes GaN.

4. The device of claim **3**, wherein the second III-N material layer includes AlGaN or AlInGaN.

5. The device of claim **2**, further including a third III-N material layer between the first III-N material layer and the second III-N material layer.

6. The device of claim **5**, wherein the third III-N material layer comprises AlN.

7. The device of claim **2**, wherein the first III-N material layer and the second III-N material layer are group III-face or [0 0 0 1] oriented or group-III terminated semipolar layers, and the second III-N material layer is between the first III-N material layer and the electrode-defining layer.

8. The device of claim **2**, wherein the first III-N material layer and the second III-N material layer are N-face or [0 0 0 1 bar] oriented or nitrogen-terminated semipolar layers, and the first III-N material layer is between the second III-N material layer and the electrode-defining layer.

9. The device of claim **2**, wherein the recess extends through the entire thickness of the electrode-defining layer.

10. The device of claim **9**, wherein the recess extends into the III-N material structure.

11. The device of claim **10**, wherein the recess extends through the 2DEG channel.

12. The device of claim **10**, wherein the recess extends at least 30 nanometers into the III-N material structure.

13. The device of claim **1**, wherein the recess extends partially through the thickness of the electrode-defining layer.

14. The device of claim **1**, wherein the electrode-defining layer has a composition that is substantially uniform throughout.

15. The device of claim **1**, wherein the electrode-defining layer comprises SiN_x.

16. The device of claim **1**, wherein a thickness of the electrode-defining layer is between about 0.1 microns and 5 microns.

17. The device of claim **1**, further comprising a dielectric passivation layer between the III-N material structure and the electrode-defining layer, the dielectric passivation layer directly contacting a surface of the III-N material adjacent to the electrode.

18. The device of claim **17**, wherein the dielectric passivation layer comprises SiN_x.

19. The device of claim **17**, wherein the dielectric passivation layer is between the electrode and the III-N material structure, such that the electrode does not directly contact the III-N material structure.

20. The device of claim **17**, further comprising an additional insulating layer between the dielectric passivation layer and the electrode-defining layer.

21. The device of claim **20**, wherein the additional insulating layer comprises AlN.

22. The device of claim **20**, wherein the additional insulating layer is less than about 20 nanometers thick.

23. The device of claim **1**, wherein the extending portion of the electrode functions as a field plate.

24. The device of claim **1**, wherein the electrode is an anode, and the device is a diode.

25. The device of claim **1**, wherein the electrode is a gate, and the device is a transistor.

26. The device of claim **25**, wherein the device is an enhancement-mode device.

27. The device of claim **25**, wherein the device is a depletion-mode device.

28. The device of claim **1**, wherein the device is a high-voltage device.

29. The device of claim **1**, wherein the effective angle is about 20 degrees or less, and a breakdown voltage of the device is about 100V or larger.

30. The device of claim **1**, wherein the effective angle is about 10 degrees or less, and a breakdown voltage of the device is about 300V or larger.

31. The device of claim **1**, wherein at least one of the steps has a first surface that is substantially parallel to the surface of the III-N material structure and a second surface that is substantially perpendicular to the surface of the III-N material structure.

32. The device of claim **1**, wherein at least one of the steps has a first surface that is substantially parallel to the surface of the III-N material structure and a second surface that is